STS-121 Return Samples: Assessment of Air Quality aboard the Orbiter and International Space Station

The toxicological assessments derived from 9 dual sorbent tubes (DSTs), 13 grab sample canisters (GSCs), and 7 pairs of formaldehyde badges returned aboard STS-121 in July 2006 are reported. Analytical methods have not changed from earlier reports. The recoveries of the 2 less volatile surrogates from the DSTs averaged 83 and 91 %; however, ^{13}C-acetone was only recovered at an average of 54 %. Correction factors were applied to volatile polar compounds due to limited recoveries by the DSTs. The average GSC surrogate recoveries were 106, 95, and 95%. Formaldehyde recoveries from 4 positive controls ranged from 99 to 122%. The two general criteria used to assess air quality are the total-non-methane-volatile organic hydrocarbons (NMVOCs) and the total T-value (minus the CO_2 and formaldehyde contributions). Control of atmospheric alcohols is important to the water recovery system engineers, hence total alcohols (including acetone) are also shown for each sample. Because formaldehyde is quantified from badges, its concentration is also listed separately. These four indices are summarized below:

Module/Sample	Approx. Date	NMVOCs (mg/m^3)	T Value[a] (units)	T Value[a] Minus siloxanes	Alcohols (mg/m^3)	Formaldehyde (ug/m^3)
SM/GSC	9/8/05	15	1.54	0.80	5.3	
Lab/GSC	9/30/05	13	1.24	0.76	6.1	
SM/GSC	10/26/05	26[b]	1.06	0.57	19[b]	
Lab/DST	10/26/05	19	1.61	0.25	3.7	
FGB/DST	10/26/05	7	0.32	0.31	4.8	
Lab/GSC	11/25/05	11	0.59	0.35	6.1	
FGB/DST	11/25/05	8	0.65	0.55	5.2	
SM/GSC	12/21/05	11	1.06	0.54	4.7	
Lab/GSC	1/18/06	14	1.31	0.57	4.6	
FGB/GSC	2/21/06	11	0.83	0.55	6.1	
Lab/GSC	3/29/06	21	3.10[e]	2.13[e]	6.3	
Lab/GSC/Form.	4/20/06	12	1.61[e]	1.49[e]	8.7	37
+DST	4/20/06	14	0.72	0.53	10	
SM/DST/Form.	4/20/06	13	0.47	0.38	9.9	34
SM/GSC/Form.	6/09/06	18	1.40	0.74	9.0	26
Lab/DST/Form.	6/09/06	56[c]	2.43	1.57[c]	35[c]	41
FGB/DST	6/09/06	17	0.89	0.66	12	
Lab/GSC/Form.	6/27/06	13	0.98	0.70	8.5	40
FGB/DST	6/27/06	24[d]	0.66	0.65	22[d]	
SM/DST/Form.	6/27/06	27[d]	0.93	0.73	22[d]	34
MPLM/GSC	7/07/06	15	1.31	0.63	3.5	
Flt-Dk/GSC/For	7/16/06	4	0.62	0.61	1.0	34
Guideline		*<25*		*<1.0*	*<5*	*<120*

[a] Both sets of T values exclude the contribution from CO2.

[b] Ethanol alone was elevated to 18 mg/m3.

[c] Ethanol was elevated to 30 mg/m3, and many other compounds were up as well. In view of values in FGB and SM samples from the same time, these high values are probably an artifact.

[d] Ethanol alone was elevated to 20 mg/m3.

[e] Large contribution from the irritant propenal (acrolein): 1.12 in 3/29 sample, and 0.76 in 4/20 sample.

Although there is a wide diversity in the T values from these samples, the air quality has not reached a point where crew health could be affected. Once the siloxanes, which are respiratory and reproductive toxicants are removed from the T calculation, and propenal, which is a respiratory and eye irritant is removed from the T calculation, the T-values are at or below 1.0 except for the spurious DST result in the Lab on 6/29/06. The alcohols consistently exceed the guideline level of 5 mg/m^3. Formaldehyde continues to be well below the guideline, with levels consistently lower in the SM when compared to the Lab.

Enclosures

Table 1A: Analytical Concentrations of ULF1.1 DST Air Samples
Table 1B: Analytical Concentrations of ULF1.1 GSC Air Samples
Table 1C: Analytical Concentrations of STS-121 GSC Air Samples
Table 2A: T-Value Calculations of ULF1.1 DST Air Samples
Table 2B: T-Value Calculations of ULF1.1 GSC Air Samples
Table 2C: T-Value Calculations of STS-121 GSC Air Samples